CLAIMS

What is claimed is:

1. An apparatus, comprising:

a first region of an optical waveguide disposed in semiconductor material, the first region having a first conductivity type;

a second region of the optical waveguide disposed in the semiconductor material, the second region having a second conductivity type opposite to the first conductivity type;

a first contact coupled to the optical waveguide at a first location outside an optical path of an optical beam to be directed through the optical waveguide;

a first buffer of insulating material disposed along the optical waveguide between the first contact and the optical path of the optical beam; and

a buffer plug of insulating material disposed in the optical waveguide on a same side as the first location, the buffer plug to help direct a mode of the optical beam away from the first location.

2. The apparatus of claim 1 wherein the first region of the optical waveguide includes a first higher doped region coupled to the first contact at the first location to improve an electrical coupling between the first contact and the optical waveguide, the buffer plug to further help direct the mode of the optical beam away from the first higher doped region.

3. The apparatus of claim 1 further comprising:

a second contact coupled to the optical waveguide at a second location outside the optical path of the optical beam, the buffer plug to further help direct the mode of the optical beam away from the second location; and

a second buffer of insulating material disposed along the optical waveguide between the second contact and the optical path of the optical beam.

4. The apparatus of claim 3 wherein the first region of the optical waveguide includes a second higher doped region coupled to the second contact at the second location to improve an electrical coupling between the second contact and the optical waveguide, the buffer plug to further help direct the mode of the optical beam away from the second higher doped region.

5. The apparatus of claim 3 wherein the first and second buffers of insulating material are laterally disposed along sidewalls of the optical waveguide to serve as cladding so as to help confine the optical beam within the optical waveguide.

6. The apparatus of claim 5 wherein the first and second buffers of insulating material are adapted to serve as electrical isolators to isolate first and second contacts from the optical path of the optical beams.

7. The apparatus of claim 1 wherein the optical waveguide comprises a rib waveguide, wherein the first region comprises a rib portion of the optical waveguide and the second region comprises a slab portion of the optical waveguide.

8. The apparatus of claim 1 wherein the optical waveguide comprises a strip waveguide.

9. The apparatus of claim 1 further comprising a third contact coupled to the second region of the optical waveguide at a third location outside the optical path of the optical waveguide, wherein the first buffer of insulating material is disposed between the third contact and the optical path of the optical beam.

10. The apparatus of claim 3 further comprising a fourth contact coupled to the second region of the optical waveguide at a fourth location outside the optical path of the optical waveguide, wherein the second buffer of insulating material is disposed between the fourth contact and the optical path of the optical beam.

11. The apparatus of claim 1 wherein a charge concentration in the optical waveguide is coupled to be modulated in response to a signal coupled to be received by the first contact.

12. The apparatus of claim 1 further comprising:

an insulating region disposed between the first and second regions of the optical waveguide; and

a charge modulated region to be modulated along the optical path of the optical beam and proximate to the insulating region between the first and second regions of the optical waveguide, the charge modulated region to modulate a phase of the optical beam to be directed through the optical waveguide.

13. A method, comprising:

directing an optical beam along an optical path through an optical waveguide disposed in semiconductor material;

applying an electrical signal to a first contact coupled the optical waveguide at a first location;

isolating the first contact from the optical path through which the optical beam is directed with a first buffer of insulating material disposed along the optical waveguide between the first contact and the optical path of the optical beam; and

directing the optical beam away from the first contact with a buffer plug of insulating material disposed in the optical waveguide on a same side of the optical waveguide as a side of the optical waveguide to which the first contact is coupled.

14. The method of claim 13 further comprising:

improving an electrical coupling between the first contact and the optical waveguide with a first higher doped region of semiconductor material included in the optical waveguide and coupled to the first contact; and

directing the optical beam away from the first higher doped region of semiconductor material with the buffer plug of insulating material disposed in the optical waveguide.

15. The method of claim 13 further comprising:

applying the electrical signal to a second contact coupled the optical waveguide at a second location; and

isolating the second contact from the optical path through which the optical beam is directed with a second buffer of insulating material disposed along the optical waveguide between the second contact and the optical path of the optical beam.

16. The method of claim 15 further comprising:

improving an electrical coupling between the second contact and the optical waveguide with a second higher doped region of semiconductor material included in the optical waveguide and coupled to the second first contact; and

directing the optical beam away from the second higher doped region of semiconductor material with the buffer plug of insulating material disposed in the optical waveguide.

17. The method of claim 13 further comprising modulating in response to the electrical signal a charge concentration along the optical path through the optical waveguide through which the optical beam is directed to phase shift the optical beam in response to the electrical signal.

18. A system, comprising:

an optical transmitter to generate an optical beam;

an optical receiver optically coupled to receive the optical beam;

an optical device optically coupled between the optical transmitter and the optical receiver, the optical device including an optical phase shifter to modulate a phase of the optical beam, the optical phase shifter including:

a first region of an optical waveguide disposed in semiconductor material, the first region having a first conductivity type;

a second region of the optical waveguide disposed in the semiconductor material, the first region having a second conductivity type opposite to the first conductivity type;

a first contact coupled to the optical waveguide at a first location outside an optical path of an optical beam to be directed through the optical waveguide;

a first buffer of insulating material disposed along the optical waveguide between the first contact and the optical path of the optical beam;

a buffer plug of insulating material disposed in the optical waveguide on a same side as the first location, the buffer plug to help direct a mode of the optical beam away from the first location.

19. The system of claim 18 wherein the first region of the optical waveguide includes a first higher doped region coupled to the first contact at the first location to improve an electrical coupling between the first contact and the optical waveguide, the buffer plug to further help direct the mode of the optical beam away from the first higher doped region.

20. The system of claim 18 wherein the optical devices further comprises:

a second contact coupled to the optical waveguide at a second location outside the optical path of the optical beam, the buffer plug to further help direct the mode of the optical beam away from the second location; and

a second buffer of insulating material disposed along the optical waveguide between the second contact and the optical path of the optical beam.

21. The system of claim 20 wherein the first region of the optical waveguide includes a second higher doped region coupled to the second contact at the second location to improve an electrical coupling between the second contact and the optical waveguide, the buffer plug to further help direct the mode of the optical beam away from the second higher doped region.

22. The system of claim 18 wherein the a charge concentration in the semiconductor material along the optical path of the optical waveguide of the phase shifter is adapted to be modulated in response to a signal coupled to be received by the first contract to modulate a phase of the optical beam to be directed through the optical waveguide.

23. The system of claim 18 wherein the optical phase shifter is included in an optical modulator to selectively modulate the optical beam.

24. The system of claim 18 wherein the optical phase shifter is included in an optical switch to selectively switch the optical beam from an input of the optical switch to one of a plurality of outputs of the optical switch.

25. An apparatus, comprising:

an optical splitter disposed in semiconductor material, the optical splitter to split an optical beam to be directed through the optical splitter into a plurality of portions of the optical beam; and

a plurality of optical phase shifters disposed in the semiconductor material, each of the plurality of optical phase shifters optically coupled the optical splitter to receive a respective one of the plurality of portions of the optical beam, the plurality of optical phase shifters adapted to adjust relative phase differences between the plurality of portions of the optical beams to control an interference resulting from the plurality of portions of the optical beams when recombined, each of the plurality of optical phase shifters including:

a first region of an optical waveguide disposed in the semiconductor material, the first region having a first conductivity type;

a second region of the optical waveguide disposed in the semiconductor material, the second region having a second conductivity type opposite to the first conductivity type;

a first contact coupled to the optical waveguide at a first location outside an optical path of a respective portion of the optical beam to be directed through the optical waveguide;

a first buffer of insulating material disposed along the optical waveguide between the first contact and the optical path of the respective portion of the optical beam; and

a buffer plug of insulating material disposed in the optical waveguide on a same side as the first location, the buffer plug to help direct a mode of the respective portion of the optical beam away from the first location.

26. The apparatus of claim 25 wherein the first region of the optical waveguide includes a first higher doped region coupled to the first contact at the first location to improve an electrical coupling between the first contact and the optical waveguide, the buffer plug to

further help direct the mode of the respective portion of the optical beam away from the first higher doped region.

27. The apparatus of claim 25 further comprising:

a second contact coupled to the optical waveguide at a second location outside the optical path of the respective portion of the optical beam, the buffer plug to further help direct the mode of the respective portion of the optical beam away from the second location; and

a second buffer of insulating material disposed along the optical waveguide between the second contact and the optical path of the respective portion of the optical beam.

28. The apparatus of claim 27 wherein the first region of the optical waveguide includes a second higher doped region coupled to the second contact at the second location to improve an electrical coupling between the second contact and the optical waveguide, the buffer plug to further help direct the mode of the respective portion of the optical beam away from the second higher doped region.

29. The apparatus of claim 25 wherein the apparatus is an optical switch adapted to control the interference resulting from the plurality of portions of the optical beams when recombined to selectively switch the optical beam to be received by one of a plurality of optical receivers in response to a signal received by at least one of the plurality of optical phase shifters.

30. The apparatus of claim 25 wherein the apparatus is an optical modulator adapted to control the interference resulting from the plurality of portions of the optical

beams when recombined to modulate the optical beam in response to a signal received by at least one of the plurality of optical phase shifters.